

German Imperial Board of Health), which seem to show that the risk of infection from tuberculous milk is surprisingly small.

Clean milk, and methods of producing and controlling it, are dealt with at some length, and some interesting details are given respecting certified milk.

A long chapter is devoted to pasteurisation of milk, and this process is strongly advocated, under proper safeguards, such as labelling with the time, temperature, and date of pasteurising, as a general method for treating the milk supply if a pure milk cannot otherwise be guaranteed.

Singularly little is said respecting infants' milk depôts. In view of the comparison made by some between the United States and this country in this respect, we should have expected more information had this method of dealing with infant mortality the importance which some would ascribe to it. Altogether the book is a valuable one, and one to read, ponder, and digest.

R. T. HEWLETT.

OUR BOOKSHELF.

Theoretische Astronomie. By Dr. W. Klinkerfues. Neubearbeitung von Dr. H. Buchholz. Dritte verbesserte und vermehrte Ausgabe. Pp. xxxviii + 1070. (Braunschweig: F. Vieweg und Sohn, 1912.) Price 50 marks.

THE claims of Klinkerfues and Buchholz are readily admitted by all acquainted with the calculation of orbits. The classical treatises of Oppolzer and Watson having run out of print, it was most fortunate that this, the practical, side of gravitational astronomy was taken up by Buchholz, who extended the original work of Klinkerfues to make it fit to take the place of the former works. The plan of dividing the subject-matter into lectures (*Vorlesungen*) is still continued, although much is unsuitable for verbal exposition. Lecture 14, for example, extends to ninety pages, and gives, besides the general theory of the earth's rotation, all the formulæ necessary for the reduction of observations.

The greater part of this edition agrees exactly with the last, but the additions are well worthy of attention. The new preface runs to twenty pages, and gives a historical treatment of recent advances in the theory of orbits. Although Gylden's work in no way enters into the subject treated in the work, Buchholz has described at some length the claims of the great Swedish astronomer. We believe that posterity will give to Gylden the place which is due to one who did much for the cause of dynamical astronomy as applied to real, in contrast with merely ideal, problems. The criticisms of Bauschinger and others have led to Harzer's method not being developed, but the vector method of Willard Gibbs is retained. We are glad to see that Leuschner's method has been introduced. The method is

carefully explained, the formulæ are collected, and a considerable number of examples are worked out. The necessary new table is given, and Oppolzer's M- and N-tables have been reproduced.

An appendix gives the known errors in the works of Bauschinger and Oppolzer on the determination of orbits.

The greatest fault of the book is its bulk. For a work intended to assist in the numerical calculation of orbits it is almost essential that the auxiliary tables should be easily manipulated. This work could with advantage be divided into several volumes.

J. JACKSON.

New Contour Map of the Near and Middle East (The Land of the Five Seas). (London: G. W. Bacon and Co., Ltd.) Price 7s. 6d.

THIS wall-map includes the empires of Babylon, Persia, Parthia, Egypt, and Rome. It shows the routes of Alexander the Great, Pompey, and St. Paul, and illustrates classical history from the earliest times. The scheme of ten colours makes it possible to show with impressive clearness the close relation between land configuration and the spread of civilisation. The scale of the map is ninety-five miles to an inch. In the bottom left corner an inset orographical map of Palestine is provided. The size of the map as a whole—40 by 30 in.—will indicate that it is scarcely large enough for use in big classes, but it should prove of service to individual students in the higher forms of secondary schools.

The Tarn and the Lake. Thoughts on Life in the Italian Renaissance. By C. J. Holmes. Pp. xi + 48. (London: Philip Lee Warner, 1913.) Price 2s. 6d. net.

THIS essay of Mr. Holmes forms very pleasant reading; originally designed as an introduction to a few studies of Italian painting and sculpture, it overran its intended bounds and became eventually the present little volume. Entertaining analogies are drawn between certain communities of fish and certain societies of men, and though the appeal is more directly to anglers, all readers who appreciate literary expression will enjoy the essay.

LETTERS TO THE EDITOR.

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Pianoforte Touch.

THE question as to whether what is known as touch is due to any peculiarity, apart from the energy, with which the hammer strikes the strings, and, consequently, with which the fingers strike the keys, would appear to be determinable by direct experiment. Personally I have always held, probably with the majority of people, that touch is dependent on such peculiarities, but the evidence seems to be decidedly against it. A note was struck one hundred times in succession so as to produce sound of as nearly as possible the same intensity; on half these occasions it was struck in a pressing, or caressing, manner; in the other cases it was struck sharply; the different

kinds of blows were intermingled irregularly, and according to a list previously drawn up, and the damper was held up while the note was being struck. As each note was struck a verdict as to its quality was given by a person sitting out of view of the piano, and this verdict was compared with the character of the blow given. The observer, it should be mentioned, was not a trained musician, but was exceptionally appreciative of what is called touch.

Discarding all cases where the note had accidentally been more or less loud than the average, it was found that in 49 per cent. of the cases of uniform loudness the effect on the auditor coincided with the character of the blow given, in 51 per cent. the reverse. In another series of 100 notes the values were 51 and 49 respectively. It is evident, therefore, according to this, that different quality of touch produces no difference in the quality of the sound produced. No doubt further evidence should be obtained by a repetition of such experiments with other performers and other observers, and a further test would be obtained by having two performers alternately striking the same note, and ascertaining whether the observer could detect the difference.

Even if the independence of "touch" on the character of the stroke is fully established, there is no difficulty in explaining the apparent difference in touch of a performance with the fingers and one with a piano-player. At least seven factors may be specified as determining touch:—(1) Differences in loudness of a note (or notes) as compared with that of the preceding notes, (2) deviation from the theoretical value, according to the score, of the duration of the note as compared with that adopted for the preceding and succeeding notes (*i.e.* different degrees of *staccato* or *legato*); (3) variations in time as compared with that of the preceding notes; (4, 5, and 6) similar differences in loudness, duration, and time of one note in reference to its nominally contemporary notes; (7) the use of the loud pedal. The use of the soft pedal is so specialised that it need not be considered; it is used more for modifying a whole passage than for modifying individual notes, and it practically gives the performer the command of a second instrument; but, perhaps, an eighth factor of a general character should be included, namely the extent to which the above means of emphasising notes is made to harmonise with the rhythm and sense of the music.

Now, in the piano-player we have the means, either by moving levers or by pressure on the bellows, of altering the loudness (1) or time (3) of a note as compared with that of preceding notes, but such alterations are gross and sluggish in comparison with those possible in finger playing; the inertia of the mechanism has to be overcome, and the result depends directly or indirectly on the pressure of air in the bellows, which cannot be altered instantaneously. The least unsatisfactory operation is a retardation of the time. The duration of the note as compared with that of its neighbours (2), or of its fellow-notes (5), as well as the loudness of it as compared with its fellow-notes (4), can only be accomplished by modifications in the slots of the roll, and they are, therefore, stereotyped and always the same; this produces a very unsatisfactory result.

When hearing for the first time a well-played piece with the air strongly brought out in this way, the impression produced is decidedly favourable, but at the second hearing a sense of irritation is felt; we know exactly the degree of emphasis which is going to be placed on each note of the air, and the monotony is even more trying than where no emphasis is attempted. It is a case similar to that of a beautiful landscape which never changes; the charm of music lies largely in its imperfections, or, at least, in the

varying and unexpected degree in which its beauties are brought out. An alteration in the time of contemporaneous notes (6) is, I believe, attempted on some rolls, but the effect, I should imagine, would be even less satisfactory than in the other cases. The use of the loud pedal is a potent defect in the piano-player. Needless to say, this pedal is not used in good finger playing only to produce loudness, but more generally to produce softness, and a smooth flow of sound. In a slow movement a good performer will often depress and raise the pedal for nearly every note, and the effect produced depends entirely on the correct timing of these movements with the depression of the keys; this is impossible unless the messages from the brain to the fingers and to the feet are simultaneous. This cannot be so with a piano-player, where the sound is produced by a separate mechanism; this sound (either of the particular note in question or of its predecessor) must travel to the brain, which then has to interpret it, and to send a message to the finger which controls the pedal lever; the performer is conscious of an act of thought being necessary in using the pedal of a player, whereas in finger playing its use appears as if it were instinctive. With the player it is practically only used for producing loudness.

I believe that the thud of the air on the keys is another defect in the player. When in the same room as the instrument, it seems possible to decide after hearing one bar whether the player or fingers are being used, and this is certainly so, as I have ascertained by trial, and apparently more easily so, when one is in a distant room, the reason of this being that the thud penetrates the walls more easily than the note, and hence attains more relative predominance. I have an instance of this in a striking clock, of which the note is inaudible in the next room, while the thud can be distinctly heard.

No doubt many of the defects of the piano-player will be diminished in time, especially by such devices as those of Prof. Bryan. Already one of the best piano-makers is putting on the market an instrument which is a great advance on its predecessors, the chief feature of it being a reduction in the size of the bellows, which admits of much greater control over the sound production. Still, it is a case of playing with the feet, instead of with ten independent fingers.

When the damper is allowed to act in the ordinary way, it is possible that the effect produced (touch) may be modified by the character of the blow given to the keys, for this blow results in the damper being raised, as well as in the hammer striking the strings, and these two actions may not synchronise to the same extent with blows of different character.

SPENCER PICKERING.

A Danger of so-called "Automatic Stability."

FROM time to time devices have been proposed for securing "automatic stability" in aeroplanes by means of a suspended weight or "pendulum," which operates on rudder-planes governing the motion of the machine. A similar device is also in actual use for governing the motion of torpedoes in a vertical plane, in conjunction with a further device for maintaining the torpedoes at a constant depth below the surface, or more strictly at a level where the hydrostatic pressure is constant. "Pendulum" arrangements for automatic stability of aeroplanes have frequently figured in the pages of such journals as *The Scientific American*, and it must be admitted that such devices are calculated to appeal strongly to the imagination of readers whose knowledge of dynamical principles is limited in range or nil.

The statement, which stands in my name, to the